Nondestructive Evaluation Program

Investigation of Penetrant Inspection Corner Crack Detectability

Completed Technology Project (2013 - 2015)

Project Introduction

The corner crack size for penetrant inspection (PT) in NASA-STD-5009 is larger and has a different aspect ratio from the size historically used in NASA fracture control. In recent applications at Goddard Space Flight Center, the result is that the corner crack configuration is the design driver. There is concern that the corner crack size is overly conservative which is resulting in overly conservative designs. This came to head with the James Webb Space Telescope (JWST) NIRSpec (Near Infrared Spectrometer) kinematic mounts where the design based on NASA Special Level PT sizes could not meet thermal performance requirements. The decision to change the size in NASA-STD-5009 was based on anecdotal cases and not based on actual PT inspection data. The objective of this task is to review existing corner crack PT inspection data, generate additional capability data using crack panels sets from JSC and GSFC and to then make recommendations about the appropriateness of the size used in NASA-STD-5009.

Objectives:

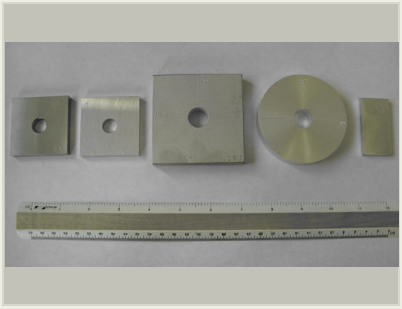
The corner crack size for penetrant inspection (PT) in NASA-STD-5009 is larger and has a different aspect ratio from the size historically used in NASA fracture control. This standard establishes the nondestructive evaluation (NDE) requirements for any metallic NASA system or component, flight or ground, where fracture control is required. In recent applications at GSFC, the result is that the corner crack configuration is the design driver. There is concern that the corner crack size is overly conservative which is resulting in overly conservative designs. This came to head with the James Webb Space Telescope (JWST) NIRSpec (Near Infrared Spectrometer) kinematic mounts where the design based on NASA Special Level PT sizes could not meet thermal performance requirements.

The decision to change the size in NASA-STD-5009 was based on anecdotal cases and not based on actual PT inspection data. The objective of this task is to review existing corner crack PT inspection data, generate additional capability data using crack panels sets from JSC and GSFC and to then make recommendations about the appropriateness of the size used in NASA-STD-5009.

Technical Methodology/Approach:

The approach will be to both review existing corner crack PT inspection data found in the NTIAC data book and other literature sources and to generate additional capability demonstration data as necessary in order to validate the corner crack size used in NASA-STD-5009.

Customers:



Corner crack specimens used in this study

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All Agency programs using fracture control supported by Nondestructive Evaluation.

Recent Accomplishments:

Four corner crack specimen sets from JSC have been shipped to GSFC for evaluation. Three sets are aluminum and one set is titanium. All sets have corner cracks at holes.

Production of set of corner cracks at a free edge is underway. Over 100 low cycle fatigue corner cracks have been generated.

Benefits/Payoffs:

The key benefit of the task are a recommendation for the detectable corner crack size for PT inspection that is supported by data.

Status:

The task was started in FY14 and initial activities are on schedule.

Additional Information:

The following figure shows the corner crack specimen configurations that will be used in the study.

Anticipated Benefits

The objective of this task is to review existing corner crack PT inspection data, generate additional capability data using crack panels sets from JSC and GSFC, and to then recommend a more appropriate size for the next revision of NASA-STD-5009. The key benefit of the task are a recommendation for the detectable corner crack size for PT inspection that is supported by data.

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Organizational Responsibility

Responsible Mission Directorate:

Office of Safety and Mission Assurance (OSMA)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Nondestructive Evaluation Program

Project Management

Program Director:

Terrence W Wilcutt

Program Managers:

Jeannette F Plante
Jason P Moore
Eric R Burke

Project Manager:

Bradford H Parker

Co-Investigator:

Justin S Jones

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.4 Information Processing

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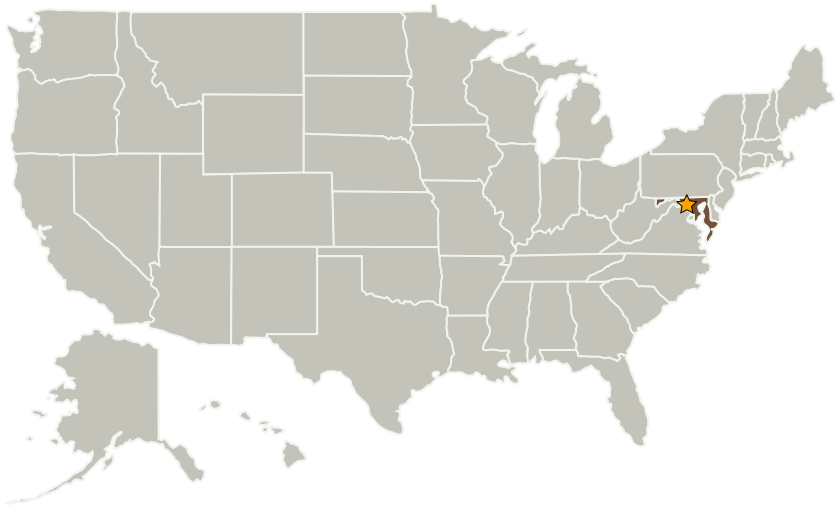
generate additional capability data using crack panels sets from JSC and GSFC and to then make recommendations about the appropriateness of the size used in NASA-STD-5009. The key benefit of the task are a recommendation for the detectable corner crack size for PT inspection that is supported by data.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Technology Areas *(cont.)*

- TX11.4.2 Intelligent Data Understanding

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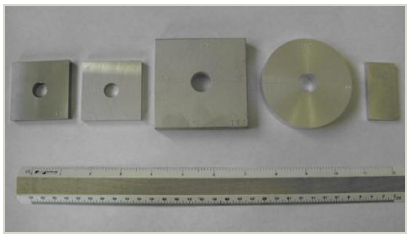
Images



Corner Crack Specimens
Corner crack specimens used in this study
(https://techport.nasa.gov/image/17657)

Stories

The Effect of Geometry on Penetrant Inspection Probability of Detection
(https://techport.nasa.gov/file/26321)

Project Website:

http://nnwg.org/innovations/gsfc/cornercrack.html